

**Utah Pre-Engineering Program  
Materials and Processes  
Standards & Objectives**

- 1. Follow safety practices**
  - 1.1 follow general laboratory safety practices
  - 1.2 follow specific equipment safety practices
  - 1.3 identify potential safety hazards
- 2. Utilize precision measurement, gage, and layout tools**
  - 2.1 measure using a rule to the 64<sup>th</sup> of an inch
  - 2.2 measure using a micrometer to the .001 of an inch
  - 2.3 measure using a micrometer to the .01 of a millimeter
  - 2.4 measure using a dial/digital caliper to the .001 of an inch
  - 2.5 measure using a universal bevel protractor
  - 2.6 square a vise using a dial indicator
  - 2.7 layout center lines using a combination square
  - 2.8 layout center lines using a Vernier height gage
  - 2.9 locate the origin of a part with an edge finder
  - 2.10 calibrate micrometers using gage standards
  - 2.11 compare measurements using gage blocks and a dial indicator
- 3. Understand the nature and properties of materials**
  - 3.1 explain the atomic structure of materials
  - 3.2 identify materials
  - 3.3 describe physical properties
  - 3.4 describe mechanical properties
- 4. Utilize manufacturing processes**
  - 4.1 sand cast an aluminum part
  - 4.2 investment cast a metal part
  - 4.3 injection mold a plastic part
  - 4.4 rotational mold a plastic part
  - 4.5 vacuum mold a plastic part
  - 4.6 mold an expandable polystyrene part
  - 4.7 lay-up a composite
  - 4.8 hot form a steel part
  - 4.9 cold form sheet metal
  - 4.10 form a part using powder metallurgy
  - 4.11 drill a hole
  - 4.12 ream a hole
  - 4.13 bore a hole
  - 4.14 mill a part
  - 4.15 turn a part
  - 4.16 saw a part
  - 4.17 grind a part
  - 4.18 broach a keyway
  - 4.19 counter bore and countersink a hole
  - 4.20 tap internal threads

- 4.21 cut external threads using a die
- 4.22 chamfer and deburr a part
- 4.23 shear a part
- 4.24 saw a board (wood)
- 4.25 plane a board (wood)
- 4.26 joint the edge of a board (wood)
- 4.27 shape the edge of a board (wood) using a router
- 4.28 operate a CNC mill
- 4.29 set-up a CNC mill
- 4.30 write a CNC milling program using G & M codes
- 4.31 write a CNC milling program using CAD/CAM
- 4.32 rapid prototype a part from a 3D parametric model
- 4.33 solder electronic components and other materials
- 4.34 weld parts
- 4.35 braze parts
- 4.36 adhere (glue) parts
- 4.37 utilize threaded fasteners
- 4.38 rivet parts
- 4.39 abrasive clean parts
- 4.40 media blast parts
- 4.41 tumble and vibrate parts
- 4.42 brush and spray finishes
- 4.43 plate and anodize parts
- 4.44 harden steel
- 4.45 temper steel
- 4.46 anneal steel
- 4.47 temper aluminum
- 4.48 dry materials
- 4.49 chemically condition materials

**5. Understanding the principles of quality control**

- 5.1 explain various inspection methods and testing operations
- 5.2 inspect using a go/no-go gage
- 5.3 inspect surface finish
- 5.4 test for hardness
- 5.5 test for tensile strength
- 5.6 calculate the mean and standard deviation of a sample or population
- 5.7 interpret normal distribution data

**6. Use, design and fabricate tooling**

- 6.1 explain tool geometry
- 6.2 grind a lathe tool (single point)
- 6.3 grind a drill bit (multi-point)
- 6.4 select cutting tool inserts and assemble tooling
- 6.5 explain location methods used in jig and fixture design
- 6.6 classify and explain uses for various jigs and fixtures
- 6.7 categorize and explain uses for clamping methods
- 6.8 design and construct jigs and fixtures

- 6.9 describe various vises and how they are used
- 6.10 describe collets and how they are used
- 6.11 describe mandrels and how they are used
- 7. Design, build, and test prototypes**
  - 7.1 design a project
  - 7.2 establish performance and testing parameters
  - 7.3 create a Gantt chart
  - 7.4 generate a cost and resource analysis
  - 7.5 build and document the fabrication process
  - 7.6 test against established parameters